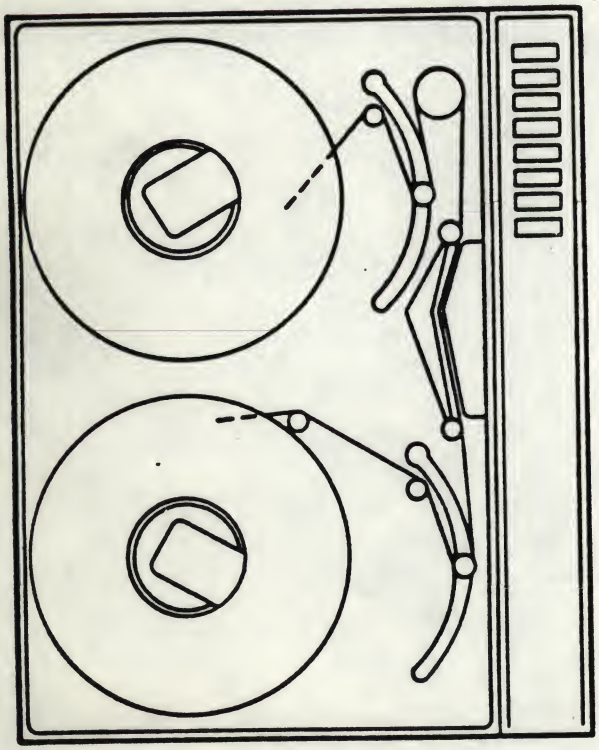
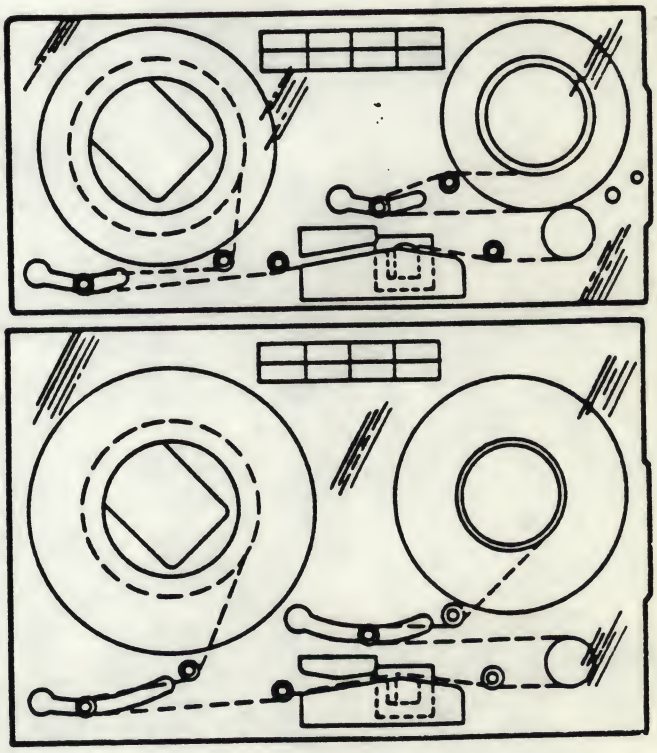
Cipher
Data Products

70-X 80-X 100-X
PRODUCT DESCRIPTION





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1.0 INTRODUCTION

Models 70X, 80X, and 100X Magnetic Tape Transports are high performance, digital, tape transports manufactured by Cipher Data Products, Inc., San Diego, California. The transports are available with a dual-gap head, providing read-after-write capability, or a single-gap head for applications where simultaneous read and write operations are not required. The Model 100X transport is designed to operate on 105- to 250-Vac, single-phase, 48- to 63-Hz line power. If the compliance arm retraction feature is not required, the transport can operate on line power frequencies up to 450 Hz. Reels to 10.5 inches (2400') in diameter can be accommodated. Models 70X and 80X are designed to operate on 117- to 230-Vac, single-phase, 48- to 400-Hz line power. The Model 70X transport accommodates a 7-inch (600') reel, while the Model 80X takes an 8-1/2-inch (1200') reel. Various tape-speed and density capabilities and other options are available, as follows:

a. Operation in the following modes:

   (1) Seven- or nine-track

   (2) Read-after-write

   (3) Read/write

   (4) Write only

   (5) Read only

b. Overwrite

c. Tape Speeds

   (1) 100X: 45, 37.5, 25, 18.75, or 12.5 ips

   (2) 80X: 37.5, 25, 18.75, or 12.5 ips

   (3) 70X: 25, 18.75, or 12.5 ips

   (4) Nonstandard: Any fixed speed within the ranges specified above.

d. Data densities: 800, 556, 200 bpi (NRZI); 1600 bpi (PE)

e. Dual-density combinations: 1600/800, 800/556, 800/200, 556/200 bpi

f. Local density selection

TABLE 1-1. COMMON SPARES

SUB-ASSEMBLIES	70X	80X	100X
Data Boards			
Phase Encode	X	X	X
NRZI	X	X	X
Dual Mode	X	X	X
EOT/BOT Assembly	X	X	X
Reel Hub Assembly	X	X	X
File Protect Switch Assembly	X	X	X
Magnetic Tape Head Assembly	X	X	X
Capstan Motor Assembly	X	X	
Transformer Assembly	X	X	
Reel Motor Assembly	X	X	
Control Switch Housing Assembly	X	X	
Hinged Standoff Assembly	X	X	
Servo PWB Assembly	X	X	
Power/Control PWB Assembly	X	X	

g. Remote density selection

h. Power: 400-Hz operation (without compliance arm retraction system)

i. Logic options

j. Embedded formatter (optional) NRZ1, PE, or PE/NRZ1

k. Dual-Mode: NRZI/PE with data densities of 800/1600 respectively.

The transports are designed to be used in data acquisition and computer processing systems in which data must be acquired and stored on magnetic tape. Writing and reading of digital data are performed in IBM-compatible, NRZI or PE format. Data recorded by 70X, 80X, and 100X transports is completely recoverable by IBM or similar equipment.

1.1 PHYSICAL DESCRIPTION

The Model 100X transport is designed to be hinge-mounted in a standard 19-inch equipment rack. The Model 70X and 80X transports are designed to be slide-mounted in a standard, 19 inch, equipment rack. All components are mounted on a precision-ground, cast-aluminum plate. When the equipment rack is securely anchored, the printed circuit boards and other internal components can be made accessible from the front by releasing the adjustable pawl fastener and either sliding the transport open or in the case of the Model 100X swinging the transport open on its hinges.

Four printed wiring boards are used in the 70X and 80X read-after-write models: a read/write board, a control/power board, and a servo board, all mounted behind the mounting plate. The Model 100X transport consists of four printed wiring boards: a read/write board, a control/servo board, and a power board, all mounted on the rear of the mounting plate.

A transparent, hinged, front cover protects the transport from dust and other foreign matter while allowing observation of tape motion. The pushbutton controls, which illuminate when the commanded sequence is complete, are mounted on the front trim panel, where they are accessible with the cover closed. The power connector is a standard, three-pin, grounded plug.

1.2 TRANSPORT MECHANICS

The reel to reel transport uses two servo-controlled, direct-drive, dc torque motors to drive the tape reels. The reels

are secured to their hubs by lever-actuated expanding rings which give a full 360 degree contact surface with the inner hub of the tape reel. On Models 70X and 80X a fixed, flanged hub is used for tape take-up instead of a take-up reel. Two spring-loaded compliance arms maintain tape tension and serve as tape-storage buffers. Model 100X has a compliance arm retractor system, energized when power is turned on, drives the compliance arms to their full-up positions for ease of tape threading. During the load sequence the compliance arms are returned to their operating positions to perform buffering and tensioning functions.

The tape path includes both roller and fixed guides, the head, cross-feed shield, and tape cleaner. The roller guides utilize precision bearings to minimize friction and reduce wear, and the wearing surfaces of the fixed guides are hard-chrome plated. The fixed guides, on each side of the head, are of the single-edge type. The outer (reference) flange of each guide is fixed to an exact dimension, and the bottom flange is spring loaded to guide the tape against the reference edge at all times. This arrangement provides minimum skew and minimizes the effect of tape width variations. In addition, the head and cross-feed shield are mounted on an adjustable plate which provides for precise azimuth alignment.

On the Model 100X a tape cleaner is mounted between the supply reel and the lower compliance arm roller guide to minimize tape contamination. On Models 70X and 80X the tape cleaner is mounted on the supply reel side of the head.

1.3 FUNCTIONAL DESCRIPTION

Figure 1-1 is a system block diagram. The 70X, 80X, and 100X transports use a 180-degree-wrap capstan drive for controlling tape movement during write, read, and rewind operations. The capstan is controlled by a velocity servo. The velocity information is generated by a dc tachometer that is directly coupled to the capstan motor shaft and produces a voltage proportional to the angular velocity of the capstan. This voltage is compared to the reference voltage from the ramp generator by means of operational amplifier techniques, and the difference is used to control the capstan motor. This capstan control technique gives precise control of tape accelerations and tape velocities, thus minimizing tape tension transients.

During a write operation, the tape is accelerated in a controlled manner to the required velocity. This velocity is

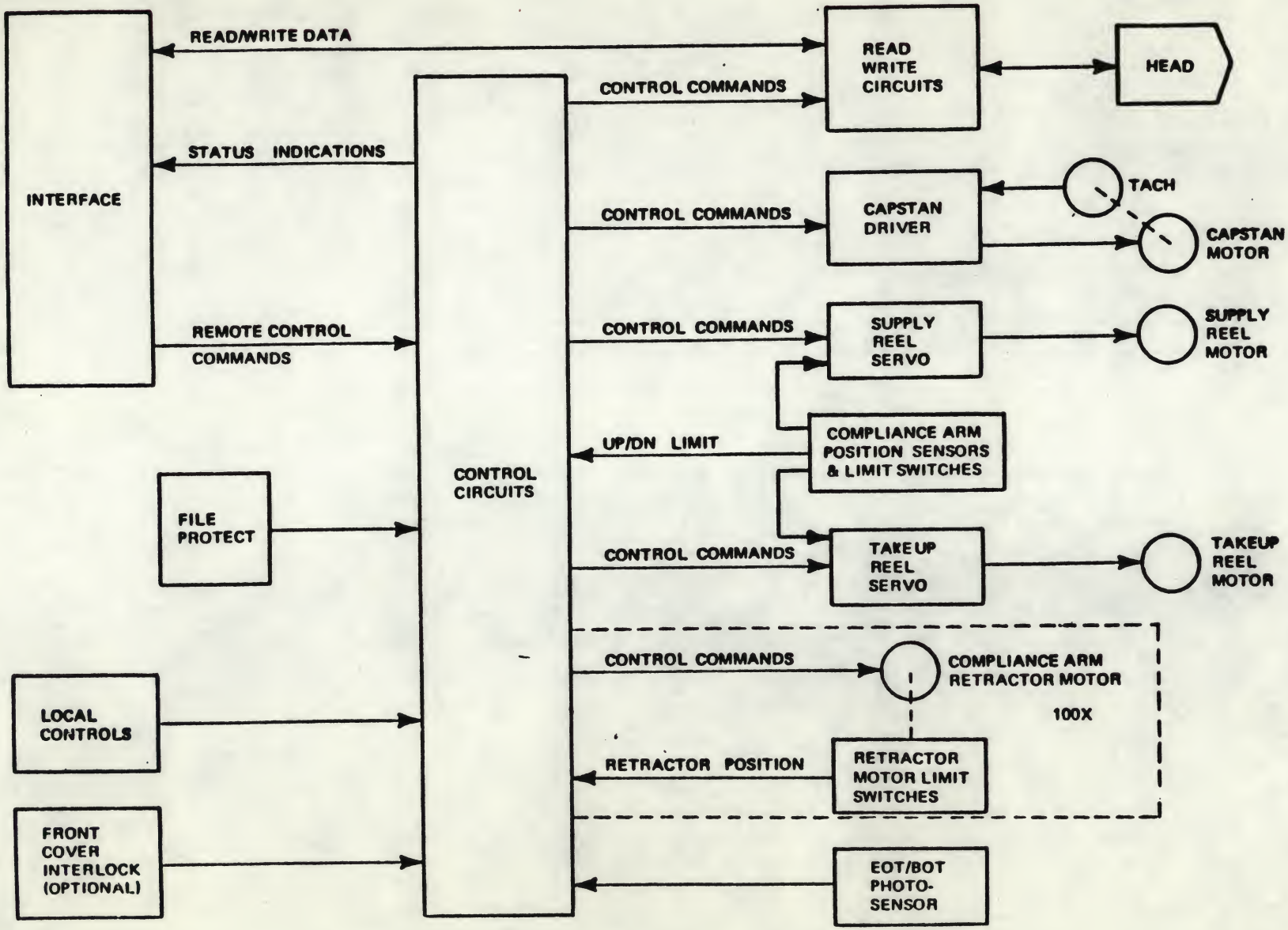
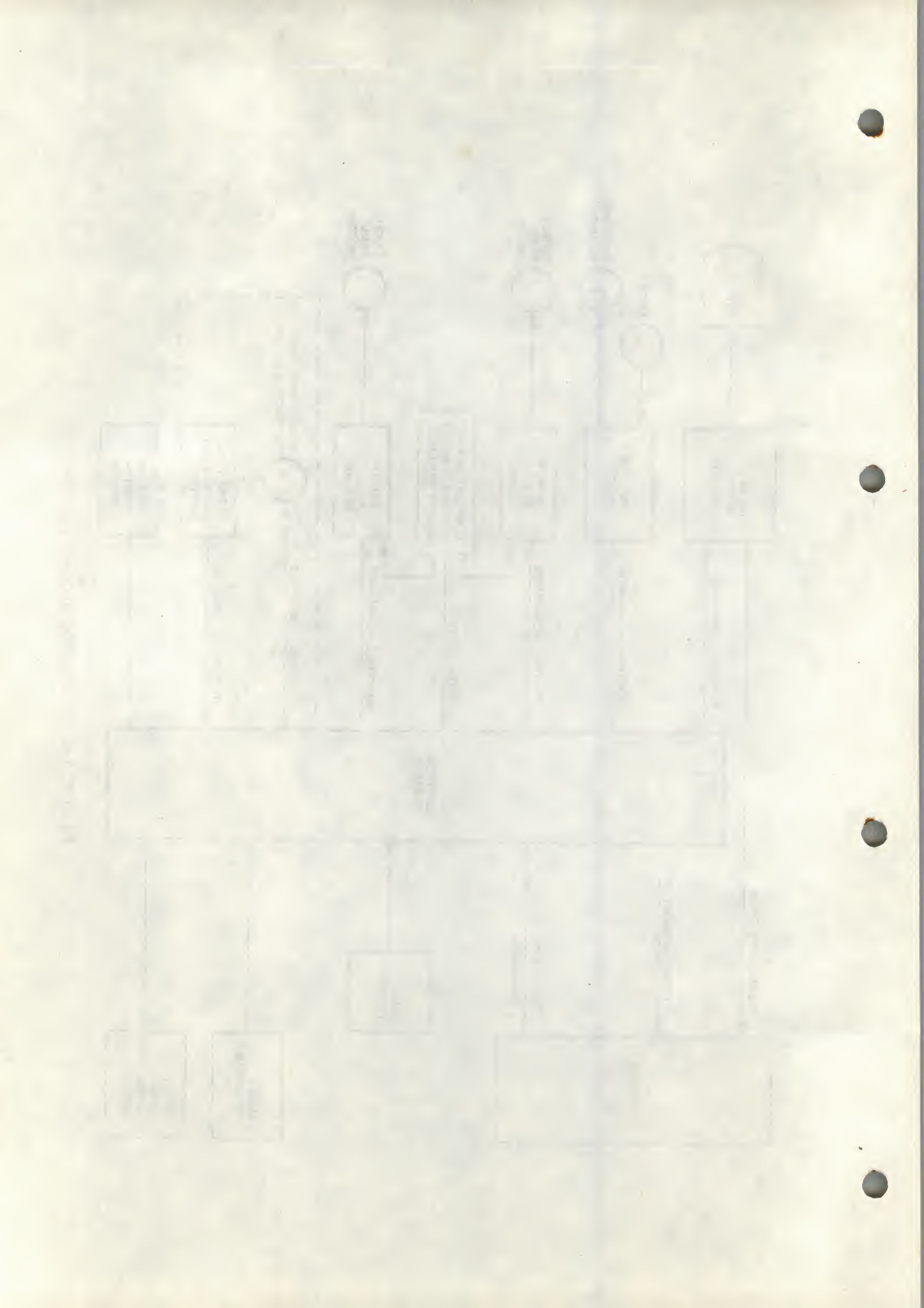


FIGURE 1-1 SYSTEM BLOCK DIAGRAM



maintained constant, and data characters are written on the tape at a constant rate. Thus, the following relationship exists:

$$\text{Bit density} = \frac{\text{Character Rate}}{\text{Tape Velocity}}$$

When data recording is complete, the tape is decelerated to zero velocity in a controlled manner. Since the write operation relies on a constant tape velocity, inter-record gaps (IRG) must be provided to allow for the tape acceleration and deceleration periods. Control of tape motion to produce a defined IRG is provided externally by the customer controller, in conjunction with the tape acceleration and deceleration characteristics defined by the recorder specifications.

An optional overwrite feature provides for editing of previously recorded data. The Overwrite signal causes Write Enable to ramp on and off, minimizing the change in inter-record gap magnetism in rewriting a record. Write Reset, used with the over-write option, causes both write head current and erase head current to be turned off immediately after writing of the new record to prevent destruction of data in the following record.

During a read operation, the tape is accelerated to the required velocity in a time interval sufficiently short to allow tape velocity to become constant before data signals are received. Seven or nine data channels are presented to the interface, depending on the recorder model. They are accompanied by a Read Data Strobe pulse derived from a monostable multivibrator circuit (NRZI). The end of a record is detected in the customer controller by means of gap-detection circuits, and the tape is commanded to decelerate in a controlled manner. The transport can operate in the read mode in either the forward or reverse direction. When operating in a shuttling mode (e.g., synchronous forward, stop, synchronous reverse, and stop) no turnaround delay is required between the end of one motion command and the beginning of the next motion command in the opposite direction. To guarantee IBM-compatible tapes, with fully saturated gaps and precise dimensions, tape motion must be allowed to cease before switching of the motion control lines and Write Enable line.

In addition to the capstan control system, the transport incorporates supply and takeup reel servo systems, a compliance arm system, a magnetic head and associated read/write electronics, and the control logic.

The compliance arms compensate for differences in tape speed arising out of the relatively fast starts and stops of the capstan and those of the slower, high-inertia supply and takeup reels. When the rate of tape travel at the capstan differs from that at which the reels are supplying or taking up the tape, the supply and/or takeup reel compliance arms move to compensate for this difference. At the same time, a photoelectric sensor measures the resulting displacement of each arm and feeds an error signal to the respective reel motor servo. This signal is amplified and is used to control the reel motor, increasing or decreasing its speed as necessary to compensate for the momentary difference in tape speed and bring the compliance arm back to its nominal operating position. The compliance arm system is designed to provide a constant tape tension of 8 ounces, as long as the arms are within their operating regions. Tape spillage is prevented, in the event power is lost, by a self-braking feature designed into the servo circuitry. When power is lost the takeup reel motor terminals are connected together through a current-limiting resistor, and the supply reel motor terminals are directly connected, producing a dynamic braking action.

The magnetic head, under control of the read/write electronics, writes and reads the flux transitions on the tape. On the read-after-write recorder, the read function is operating continuously, while the write function must be enabled in order to operate. On the recorder with the single-gap head, the read and write functions are controlled by remote command. An erase head provides continuous dc erasure across the full width of the tape during write operations.

The control logic operates on manual commands to enable tape, once loaded, to be brought to the load point. At this stage remote commands control tape motion, writing, and reading. The logic also provides rewind and unload functions in conjunction with the manual REWIND control. A photoelectric sensor assembly, consisting of a lamp and two phototransistors, is used to detect the beginning-of-tape (BOT) and end-of-tape (EOT) markers as well as unthreaded or broken tape. The detection area of the sensor assembly is approximately 1.2 inches from the write head gap.

The read/write electronics, that can be used by the tape transports mentioned have been engineered with simplicity and modern day technology in mind. The data board is capable of operating at speeds in a range of 12.5 ips thru 125 ips. Speed change kits consist of components that insert into sockets. Also, the data electronics can be operated in a NRZI/PE mode of digital recording. With the Cipher dual-mode data PWB, it is possible to write all 1's

on a tape without the use of external test equipment. There is a visual indication of out-of-tolerance read skew, and a variety of DIP switch settings are available to aid the technician in troubleshooting. With improved design, the alignment potentiometers have been reduced in quantity from twenty-seven to nine. The nine adjustable potentiometers are used to adjust the NRZI/PE read recovery circuit gains. NRZI write deskew adjustments were difficult, time consuming, and error prone alignments on the data board. They are, for the first time, ended. The nine adjustable NRZI write deskew monostable multivibrators have been replaced with a 8X32 PROM; which is preprogramed to compensate for the write head gap scatter. To improve reliability, the overall parts count was cut 40%, which decreased the power consumption by one-half. (These numbers are in comparison with the older design.) Initial read head amplifiers are specially designed for high common mode rejection and no crossover distortion. This gives consistent and improved flux reversal resolution, so important in the phase encode mode. Hysteresis TTL receivers for all channel inputs to the write logic give protection from externally generated transients. Time domain filtering on the write reset and write strobe gives additional immunity on these strategic lines. Linear phase response active filters provide unwanted signal attenuation with impact on the desired signals. A special dual-operation threshold circuitry reduces IRG drop-in type noise while allowing a lower read threshold for increased data recovery. This allows accurate rendition of the postamble to IRG transition. Also, threshold circuitry has been revised to eliminate bit shift arising from envelope variations. Write circuitry rise and fall times have been decreased for improved resolution in Phase-encode operation. Use of crosshatch power and ground distribution has increased the signal to noise ratio. At frequencies under 200 MHz, the board acts like a ground plane, giving low noise generation and pickup. All the features taken into account means improved data reliability in the host system. Figures 2-1 and 2-2 illustrate block diagrams of the write data and read data circuitry.

2.0 OPERATION

Control/indicator types, functions, and the conditions required for enabling the corresponding functions are given in Table 2-1.

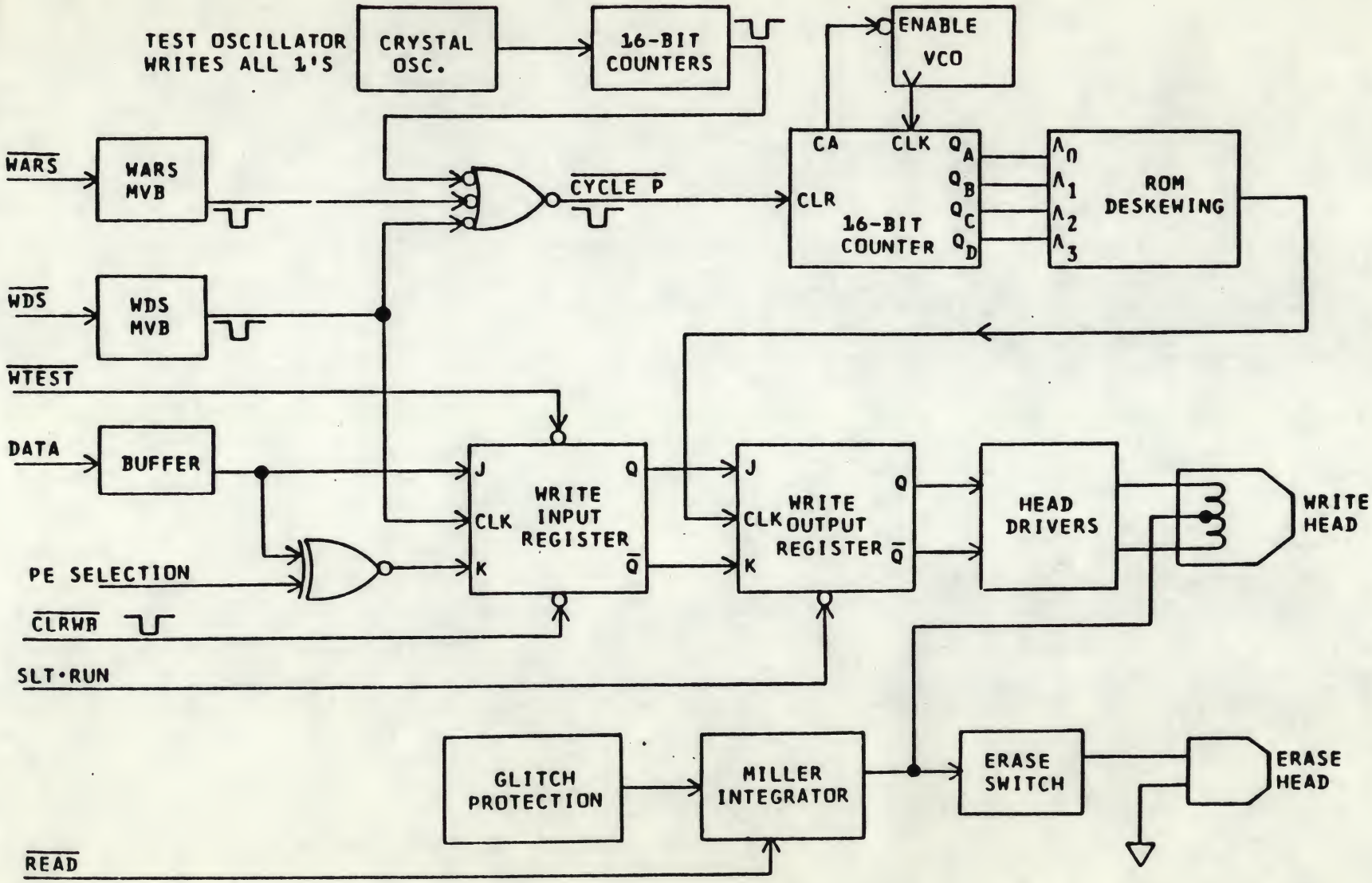


FIGURE 2-1 WRITE DATA BLOCK DIAGRAM

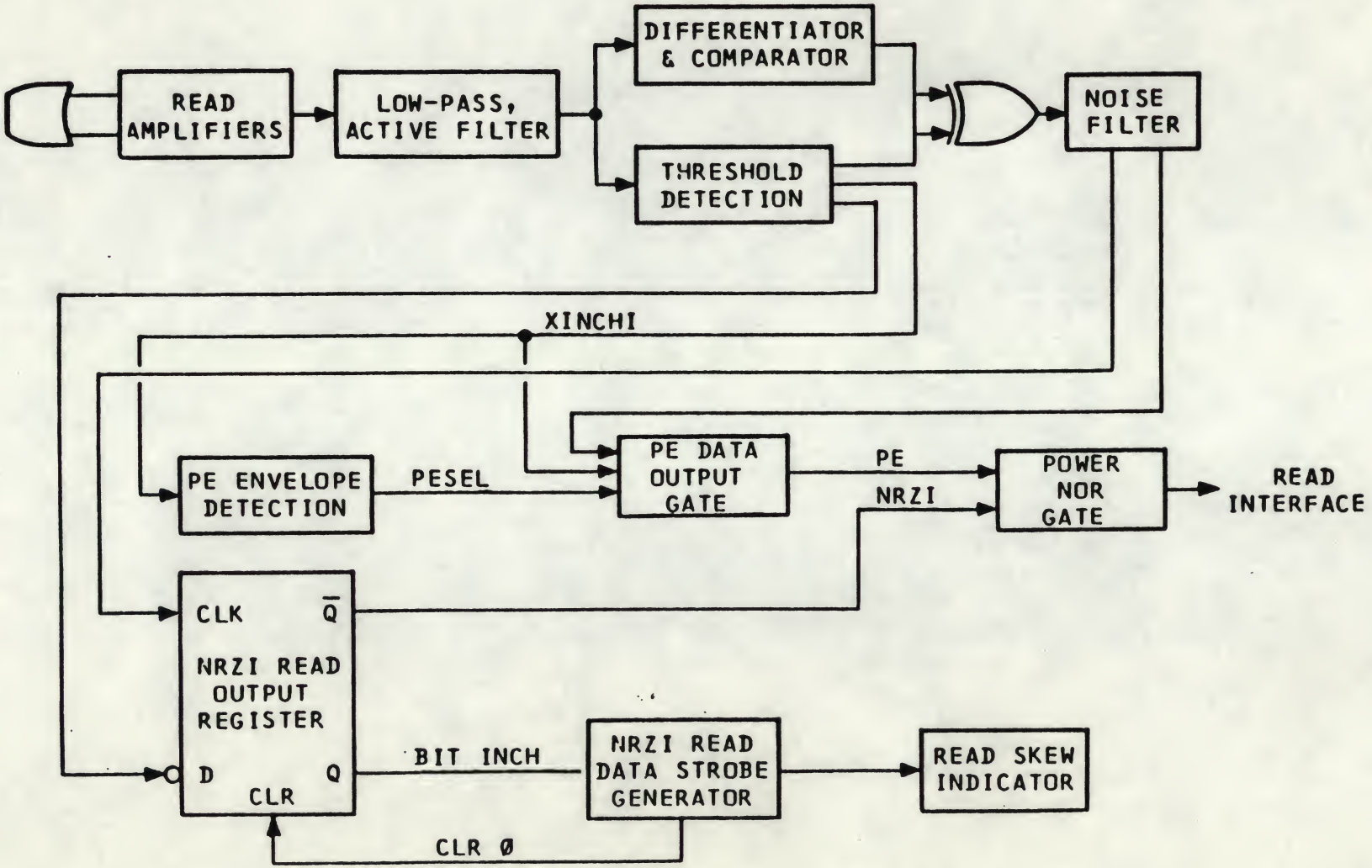


FIGURE 2-2 READ DATA BLOCK DIAGRAM

TABLE 2-1. CONTROLS AND INDICATORS

CONTROL OR INDICATOR	TYPE	FUNCTION	CONDITIONS
POWER	Alternate-Action Pushbutton/Indicator	Switches line Power on and off. Illuminates red to indicate power is on.	Fuse installed. Line cord connected.
LOAD	Momentary-Action Pushbutton/Indicator	Initial actuation energizes motors and servo system and tensions tape.	Power restored after being off. Loss of tape tension.
		Second actuation advances tape to load point.	Motors and servo system energized. Tape tensioned by initial actuation.
		Illuminates to indicate BOT tab is positioned at photosensor.	
ON LINE	Momentary-Action Pushbutton/Indicator	Switches recorder to on-line mode. Illuminates to indicate recorder is on line.	Initial Load or Rewind actuation. Recorder in off-line mode. (ON-LINE indicator extinguished.)
		Second actuation switches recorder off line. Indicator extinguished to indicate recorder is off line.	Recorder in on-line mode. (ON-LINE indicator illuminated.)
REWIND	Momentary-Action Pushbutton/Indicator	Rewinds tape to load point. REWIND indicator illuminates during rewinding then goes out.	Recorder in off-line mode. (ON LINE indicator not illuminated.

TABLE 2-1. CONTROLS AND INDICATORS (Continued)

CONTROL OR INDICATOR	TYPE	FUNCTION	CONDITIONS
REWIND (Continued)		LOAD indicator illuminates to indicate BOT tab is positioned at photosensor.	
		Second actuation of REWIND pushbutton unloads tape.	
WRT EN (Write Enable)	Indicator	Illuminates to indicate write function may be performed.	Tape reel with write enable ring installed mounted on supply hub.
HI DEN (High Density)	Alternate-Action Pushbutton/Indicator	Selects read density. Illuminates to indicate high-density mode is selected.	
FORWARD	Alternate-Action Pushbutton/Indicator	Starts/stops tape forward motion. Illuminates to indicate recorder in forward mode.	Recorder in offline mode (ON LINE indicator extinguished).
REVERSE	Alternate-Action Pushbutton/Indicator	Starts/stops tape reverse motion. Illuminates to indicate recorder in reverse mode.	Recorder in offline mode (ON LINE indicator extinguished).

2.1 LOADING TAPE

To load tape, see Figure 2-3 or 2-4 and proceed as follows:

a. Pull out reel-locking level on supply hub. Ensure that tape reel has write enable ring installed if Write mode is to be utilized. Place reel of tape on hub so that tape will unwind when reel is rotated in clockwise direction. Press reel evenly and firmly against hub's back flange and push in locking lever. Spin reel counterclockwise while looking along its rim to ensure even mounting.

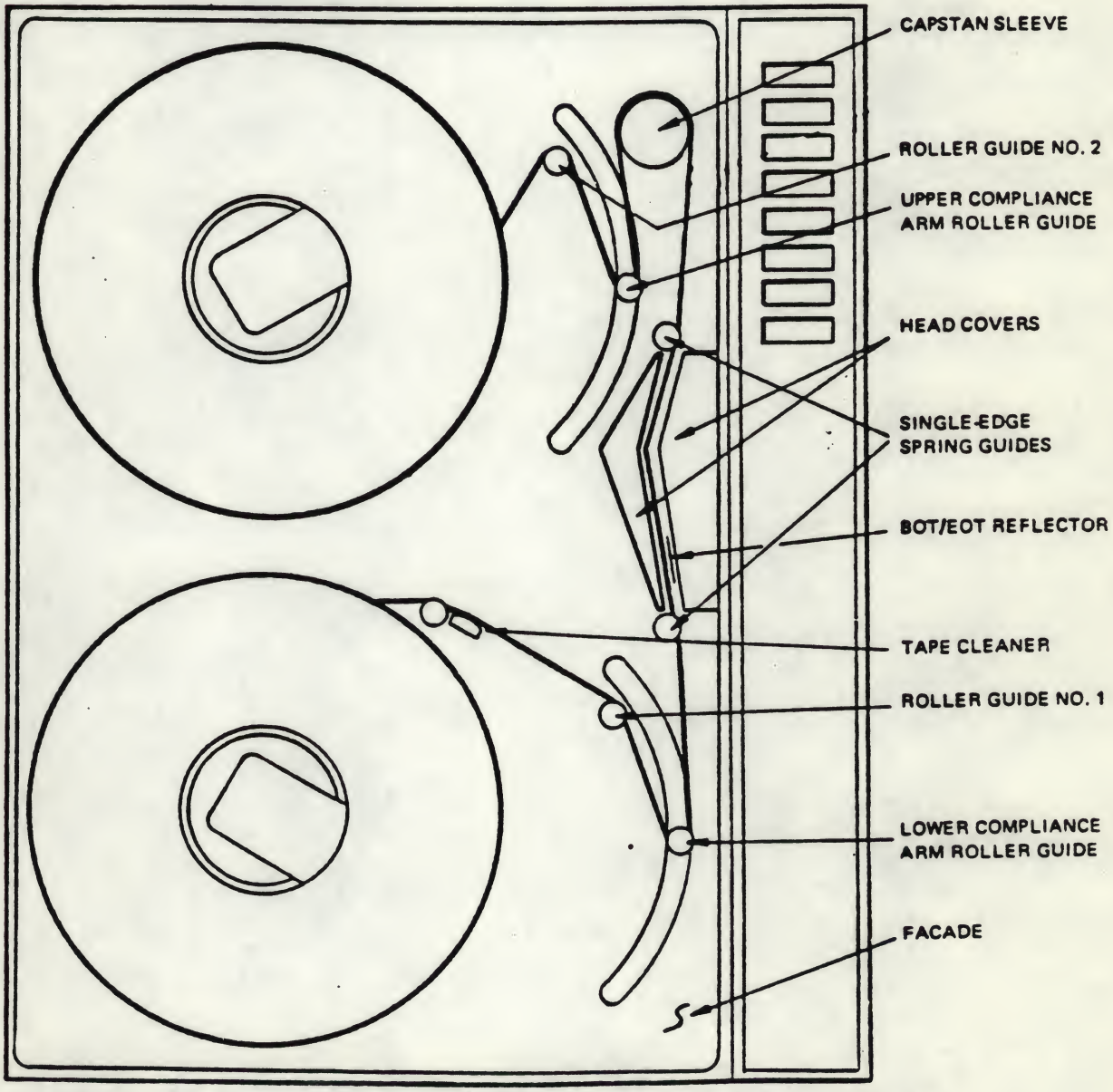
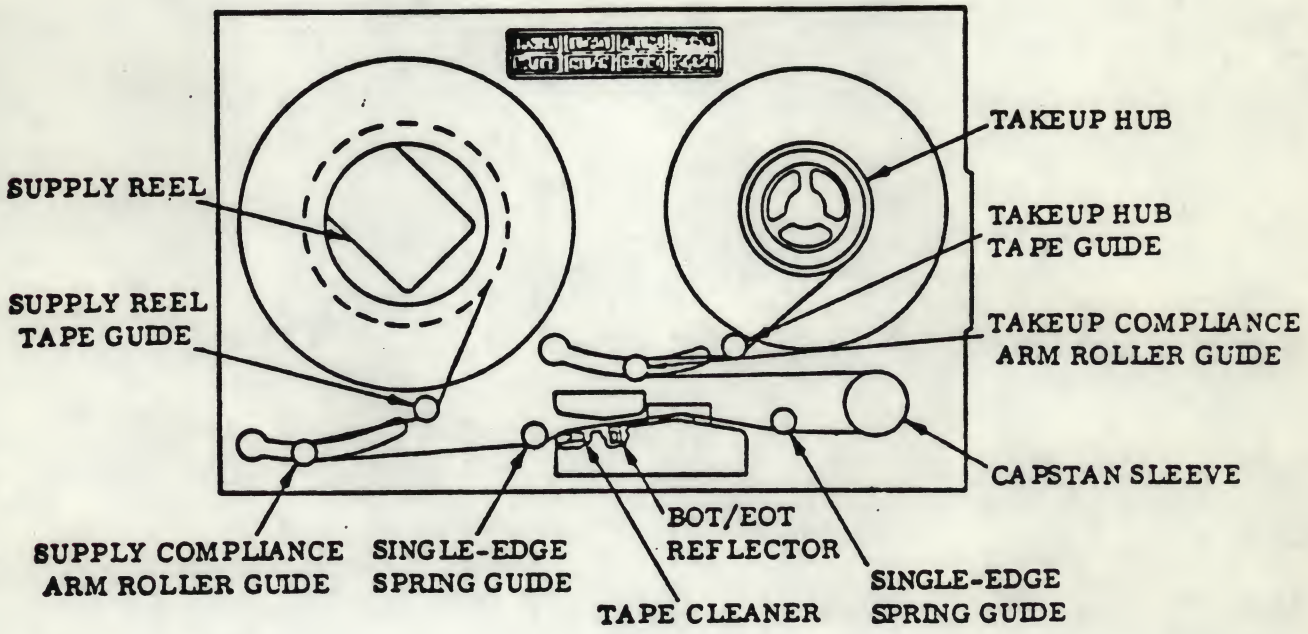


FIGURE 2-3 MODEL 100X TAPE PATH AND RELATED PARTS

MODEL 80X



MODEL 70X

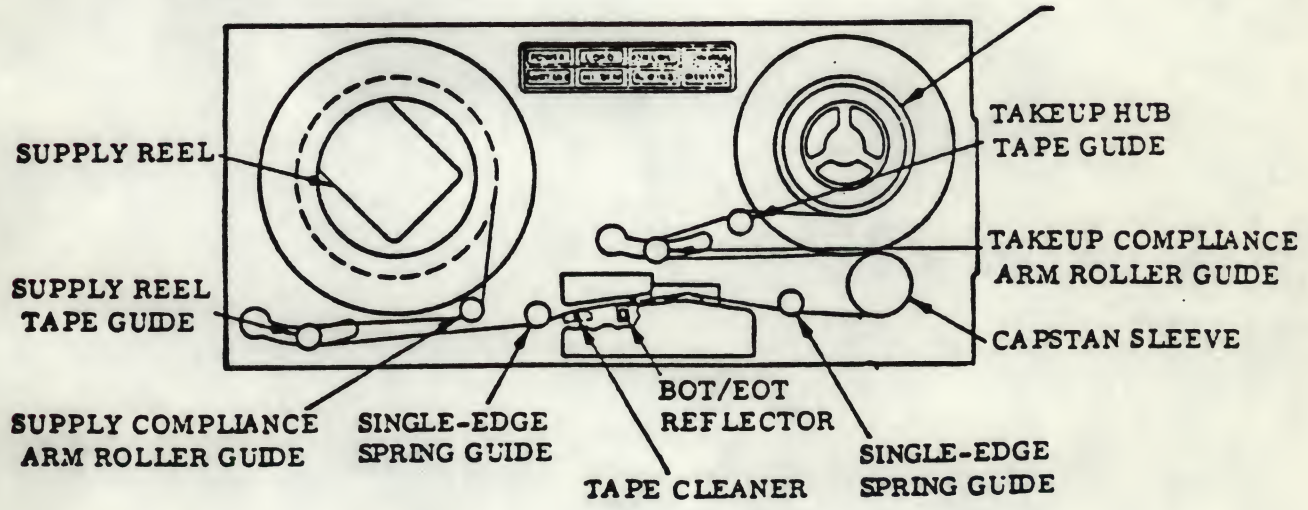


FIGURE 2-4 TAPE PATH AND RELATED PARTS

b. Install empty reel on takeup hub in same manner as loaded reel was mounted in step a.

c. Actuate POWER pushbutton. POWER indicator will illuminate.

d. Thread tape along path shown in Figure 2-4. Wrap several turns clockwise around takeup reel. Check that tape is correctly seated on guides and properly threaded through photosensor and head assembly.

e. Close front cover to protect tape and transport from dust.

f. Actuate LOAD pushbutton and observe that tape is tensioned. Actuate LOAD pushbutton again. Tape will advance until BOT tab is positioned at photosensor. LOAD indicator will illuminate, indicating recorder is ready for use.

2.2 UNLOADING TAPE

To unload the tape, proceed as follows:

NOTE

Transport must be in off-line mode (ON LINE indicator extinguished).

a. If power is off, actuate POWER pushbutton and proceed to step b. If power is on, start with step c.

b. Actuate LOAD pushbutton to tension tape.

c. Actuate REWIND pushbutton. REWIND indicator will illuminate. If tape is at load point tape will rewind until tension is lost. If tape is not at load point, rewind ceases when BOT tab is reached. BOT tab is then positioned automatically at photosensor, and LOAD indicator illuminates. Actuate REWIND pushbutton second time to complete unload sequence

- Manual REWIND command will override load sequence. This can be used to return tape to load point in event load sequence is inadvertently initiated after BOT tab has passed photosensor.

3.0 SPECIFICATIONS

Mechanical and electrical specifications are given in Table 3-1. Signal characteristics are as follows:

a. Levels

(1) True is low: 0 to 0.4 volt (approximately)

(2) False is high: +3 volts (approximately)

b. Pulses

(1) Levels as above.

(2) Edge transmission delay over 20 feet of cable is not greater than 200 nanoseconds.

The interface circuits are so designed that a disconnected wire results in a false signal. Figure 3-1 shows the interface configuration for which the recorder is designed.

3.1 INTERFACE CONNECTIONS

Interconnection of Cipher Data Products and customer equipment requires a harness of individual twisted pairs, each with the following characteristics:

a. Maximum length of 20 feet

b. Not less than one twist per inch.

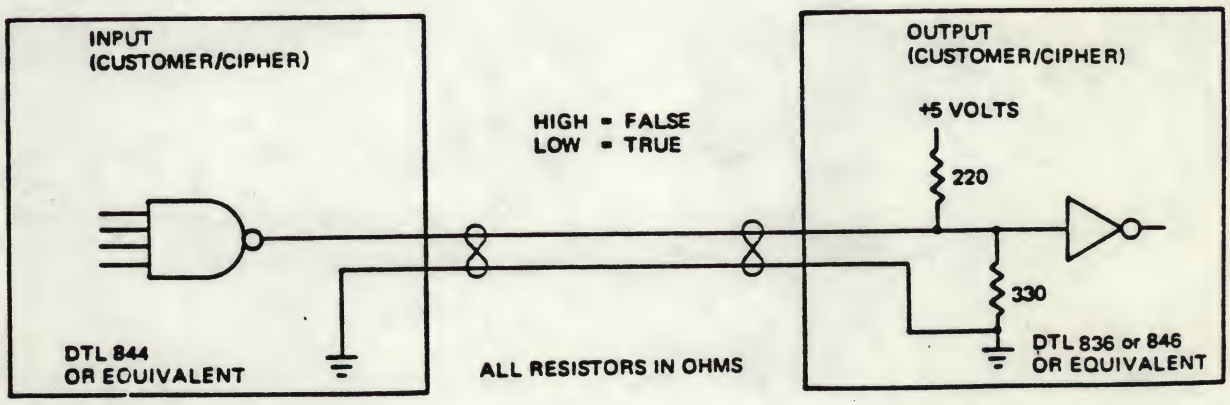


FIGURE 3-1 INTERFACE CONFIGURATION

TABLE 3-1. MECHANICAL AND ELECTRICAL SPECIFICATIONS

	70X	80X	100X
Net Weight	40 lbs (18.14 kg)	40 lbs (18.14 kg)	80 lbs (36.29 kg)
Shipping Weight	50 lbs (22.6 kg)	50 lbs (22.6 kg)	117 lbs (45.36 kg)
Dimensions			
Height	8.72 inches (24.2 cm)	12.22inches (31.1 cm)	24.0 inches (62.2 cm)
Width	19.0 inches (48.3 cm)	19.0 inches (48.3 cm)	19.0 inches (48.3 cm)
Depth (from mounting surface)	10.0 inches (25.3 cm)	10.0 inches (25.3 cm)	12.5 inches (31.8 cm)
Depth (total)	12.75inches (32.3 cm)	12.75inches (32.3 cm)	15.1 inches (38.4 cm)
Mounting (standard 19-in RETMA rack)	EIA Specifications	EIA Specifications	EIA Specifications
Power	117/230 Vac; 48 to 400 Hz; 300 Watts, Max.	117/230 Vac; 48 to 400 Hz; 300 Watts, Max.	115/230 Vac; 48 to 63 Hz (400 Hz model available without compliance arm retraction system.) 275 Watts, Max.
Fuse	3.0 amperes, 3AG, slow blow, 250 Vac	3.0 amperes, 3AG slow blow, 250 Vac	6.25/3.0 ampere, 3AG slow blow 115/230 Vac
Tape (computer grade):			
Width	0.5 inch (1.27 cm)	0.5 inch (1.27 cm)	0.5 inch (1.27 cm)
Thickness	1.5 mil (0.04 mm)	1.5 mil (0.04 mm)	1.5 mil (0.04 mm)
Reel Diameter	7 in (17.8 cm)	8.5 in (21.6 cm)	10.5 in (26.67 cm)
Tape Tension	8 ounces (226.8 grams)	8 ounces (226.8 grams)	8 ounces (226.8 grams)

TABLE 3-1. MECHANICAL AND ELECTRICAL SPECIFICATIONS (Continued)

	70X	80X	100X
Recording Mode & Density			
Seven-Track: IBM-compatible NRZI	200/556/800 bpi	200/556/800 bpi	200/556/800 bpi
Nine-Track: IBM-compatible NRZI	800 bpi	800 bpi	800 bpi
Nine-Track: IBM-compatible PE	1600 bpi	1600 bpi	1600 bpi
Nine-Track: IBM-compatible NRZI/PE	800/1600 bpi	800/1600 bpi	800/1600 bpi
Tape Speed	25/18.75/12.5 ips	37.5/25/18.75/12.5 ips	45/37.5/25/18.75/12.5 ips
Speed Variation			
Instantaneous	±5% (max., byte to byte)	±5% (max., byte to byte)	±3% (max., byte to byte)
Long Term	±1% (max.)	±1% (max.)	±1% (max.)
Rewind Speed	80 ips	100 ips (nom.)	150 ips (nom.)
Start/Stop Time (inversely proportional to tape speed)	15.0 (±0.55) ms @ 25 ips	10.0 (±0.55) ms @ 37.5 ips	8.0 (±0.55) ms at 45 ips
Start/Stop Distance	0.19 (±0.02) inch. 0.48 (±0.05) cm	0.19 (±0.02) inch 0.48 (±0.05) cm	0.19 (±0.02) inch 0.48 (±0.05) cm
Interchannel Displacement Error:			
800 bpi	150 microinches (0.004 mm) max.	150 microinches (0.004 mm) max.	150 microinches (0.004 mm) max.
556 bpi	200 microinches (0.005 mm) max.	200 microinches (0.005 mm) max.	200 microinches (0.005 mm) max.

TABLE 3-1. MECHANICAL AND ELECTRICAL SPECIFICATIONS (Continued)

	70X	80X	100X
Beginning of Tape (BOT) and End of Tape (EOT) detectors	Photoelectric (IBM-compatible)	Photoelectric (IBM-compatible)	Photoelectric (IBM-compatible)
Interface	DTL (Low True)	DTL (Low True)	DTL (Low True)
Electronics	All silicon	All silicon	All silicon
Operating Temperature	2° to 50°C	2° to 50°C	2° to 50°C
Relative Humidity	15 to 95%, noncondensing	15 to 95%, noncondensing	15 to 95%, noncondensing
Altitude	20,000 feet (6096 meters) max.	20,000 feet (6096 meters) max.	20,000 feet (6096 meters) max.

c. A 22 or 24-gauge conductor with minimum insulation thickness of 0.01 inch.

It is important that the ground side of each twisted pair be grounded within a few inches of the driver to which it is connected. The mating connectors (ELCO part number 00-6007-036-980-002 or equivalent) must be wired by the customer. As shown in Figure 3-2, interface signals are routed directly to and from the printed circuit boards. Strain relief should be provided. Table 3-2 shows the input/output lines required.

3.2 MULTIPLE-TRANSPORT (DAISY-CHAIN) SYSTEM MODIFICATION

Some system configurations require multiple tape transports; this can be accomplished by daisy-chaining the transports serially and then giving a specified address (ISLTØ - ISLT3) to each transport. The magnetic tape controller then can address one of four tape transports at any time. Each tape transport contains termination (220/330 ohm) resistor DIP packs in IC sockets. In a multiple transport system, it is necessary to remove the resistor packs from their sockets on all but the last transport.

The Cipher daisy chain cables have the following features:

a. made from flat ribbon cable.

b. compatible with the existing edge connectors.

c. standard length of 6 feet tape transport to tape transport.

d. controller to tape transport cable is 10 feet long.

The daisy-chain kit, if you were going to daisy-chain two tape drives and operate them through a Cipher formatter, will contain an MTU cable which is the cable that comes from the formatter to the first tape drive. These are three flat ribbon cables bundled together. At the formatter end you will have a printed wiring board with the standard 100 pin edge connector (Cipher Part No. 154030-102). At the tape drive end there will be two smaller printed circuit boards with edge connectors and one slightly larger PWB (Cipher Part No. 154030-001). The largest of the three contain a rotary select switch, an IC socket and molex connector. This PWB will be plugged into J101. The purpose of the IC socket is to contain the termination resistor pack, if this was the only tape drive on the chain. If it is the first tape drive of two or more, of course you would leave the resistor pack out of all IC sockets except the last drive.

The molex connector is for those machines that can accommodate a unit select switch. The unit select switch being an option, would then plug into the PWB which connects to J101. If you do not have a unit select switch, the printed wiring board contains a small rotary switch. This switch allows you to physically make the first drive unit Ø, 1, 2, or 3. The other two printed wiring boards, one of which also contains an IC socket for the write terminators are for the read and write connections. The read printed wiring board and its connector contains no IC socket.

If you are looking at the second tape drive in the daisy-chain, then the other three cables that you receive, on one end would contain a small 3M connector which you plug into the previous adaptor boards that were plugged into tape drive number one. The opposite end would contain edge connectors and three of the printed wiring boards that we have discussed above.

Cipher's scheme of daisy-chain is very realistic, practical method of accommodating the differences in the control cables between a unit that has unit select and one that does not have unit select. Most competitive companies have to offer more than one type of daisy-chain cable for the control side due to the unit select and no unit select features. However, at Cipher we are able to do that with one daisy-chain cable.

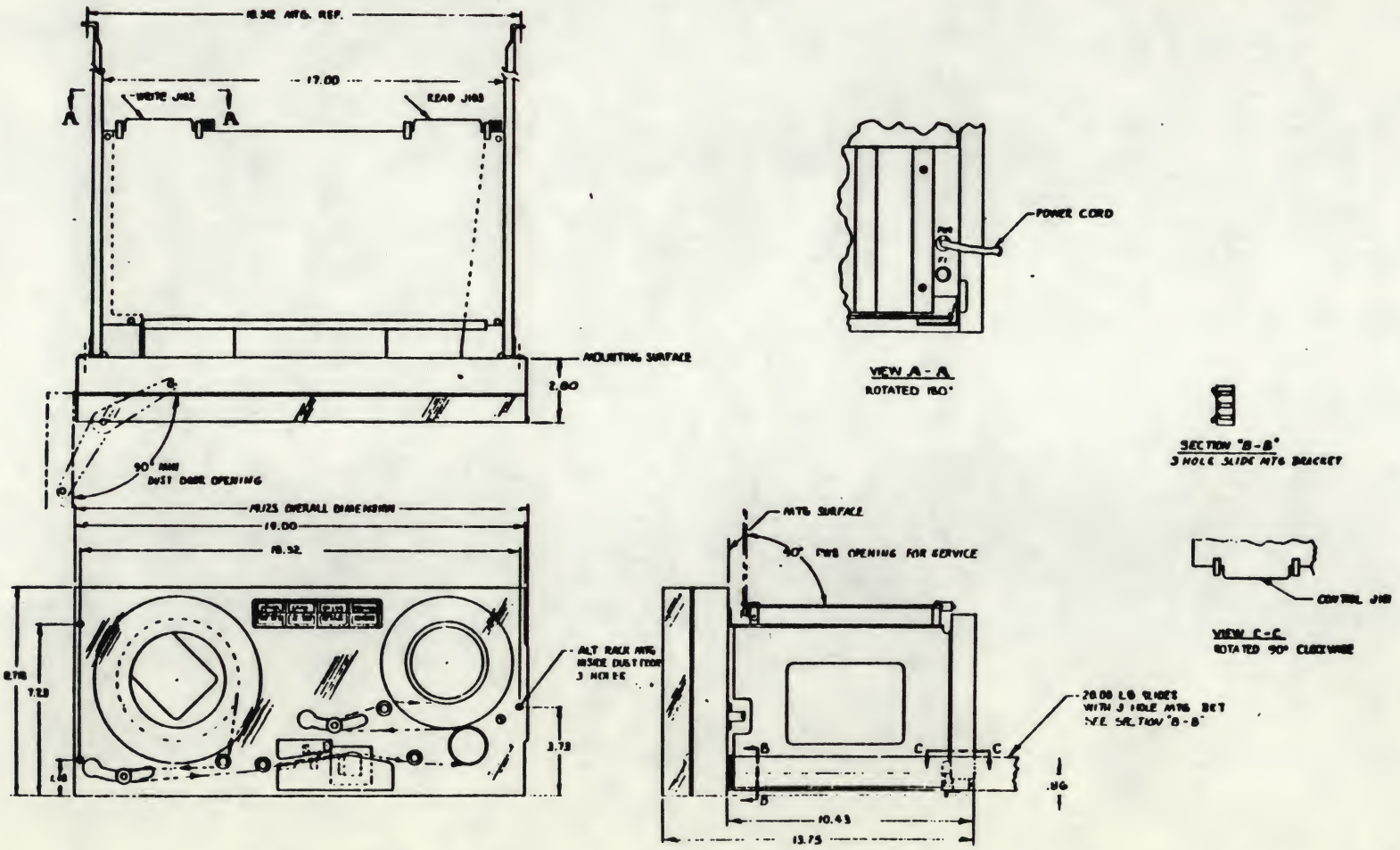
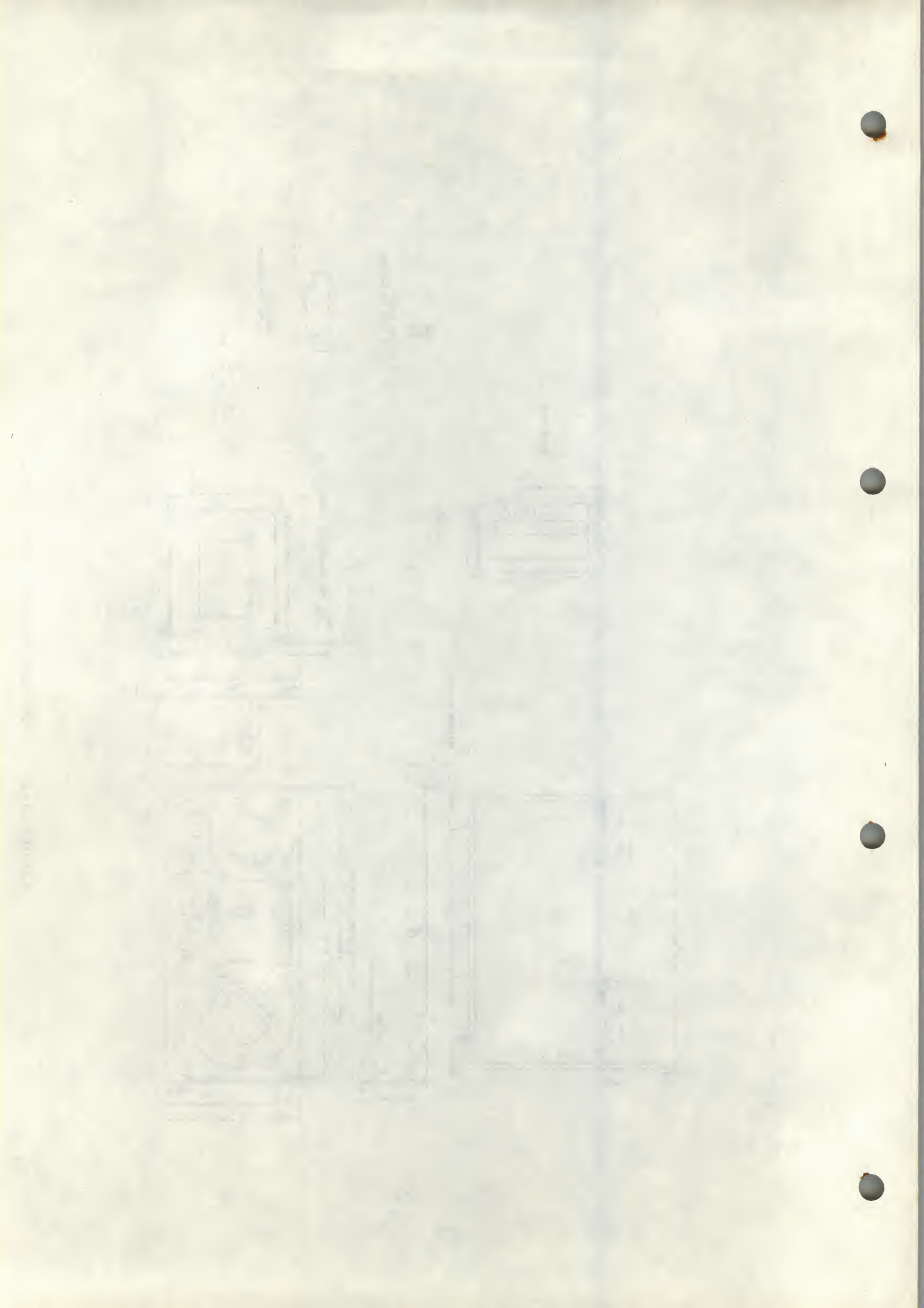


FIGURE 3-2 OUTLINE DIMENSIONS, MODEL 70X



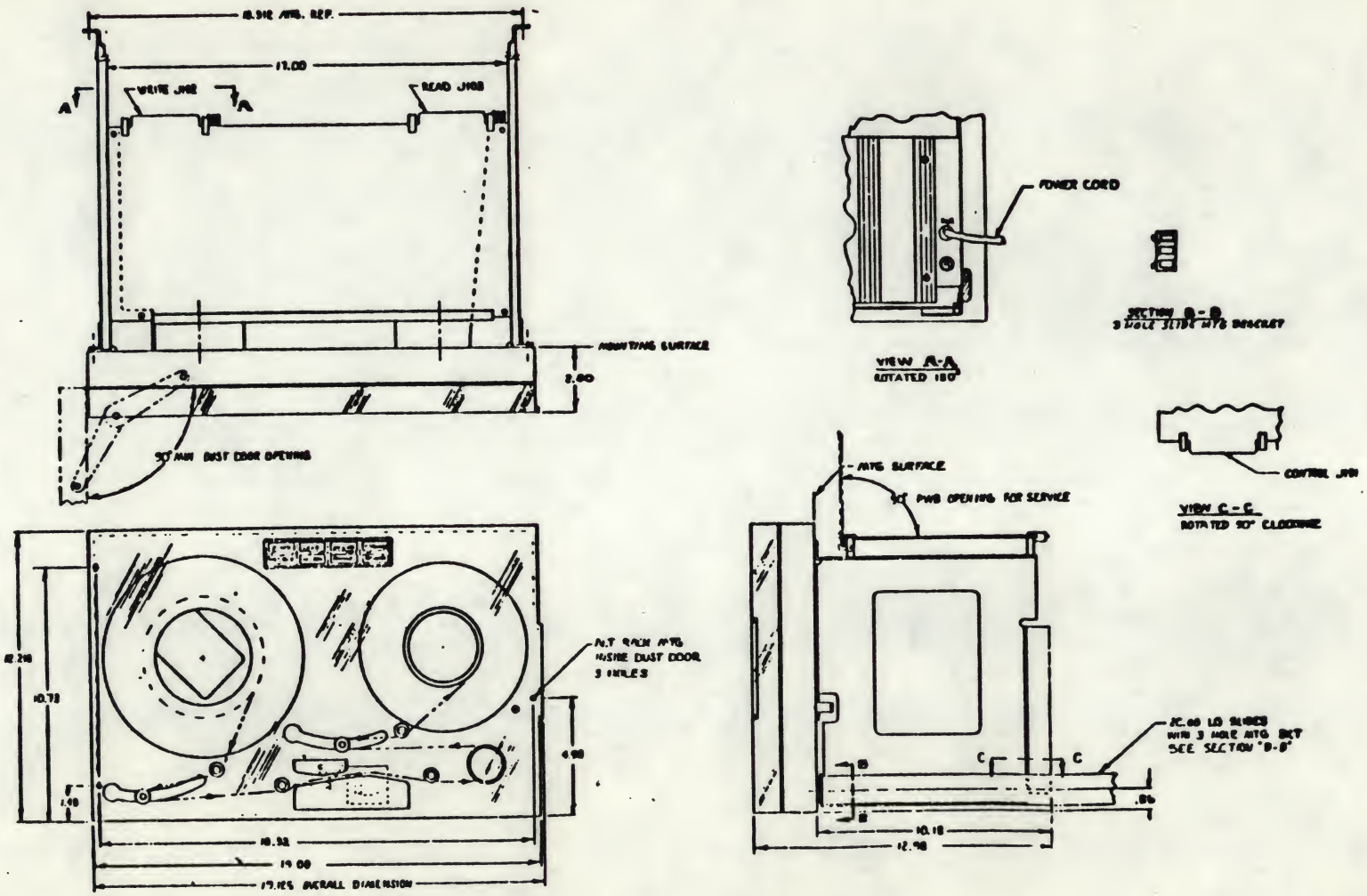


FIGURE 3-3 OUTLINE DIMENSIONS, MODEL 80X

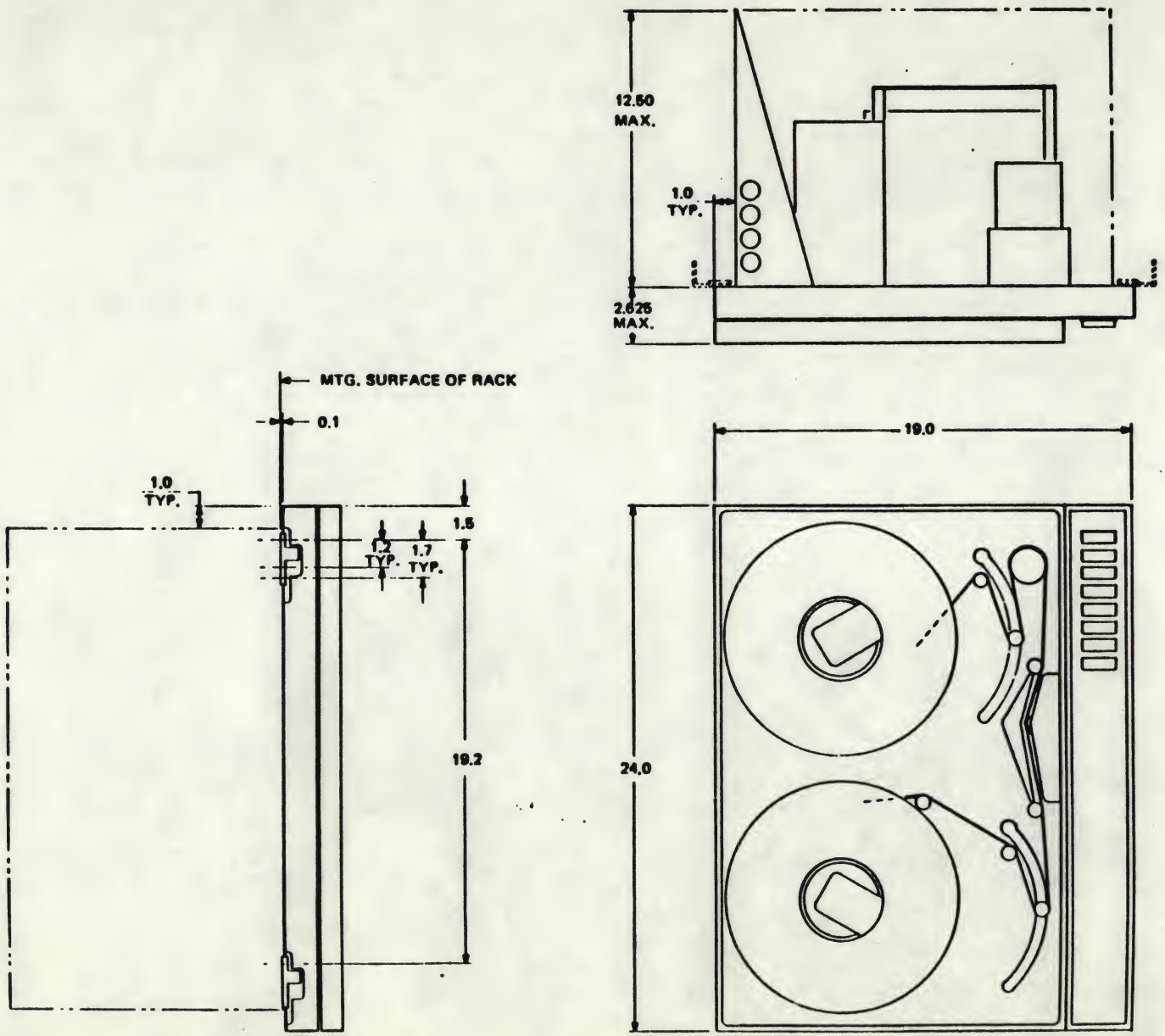


FIGURE 3-4 OUTLINE DIMENSIONS, MODEL 100X

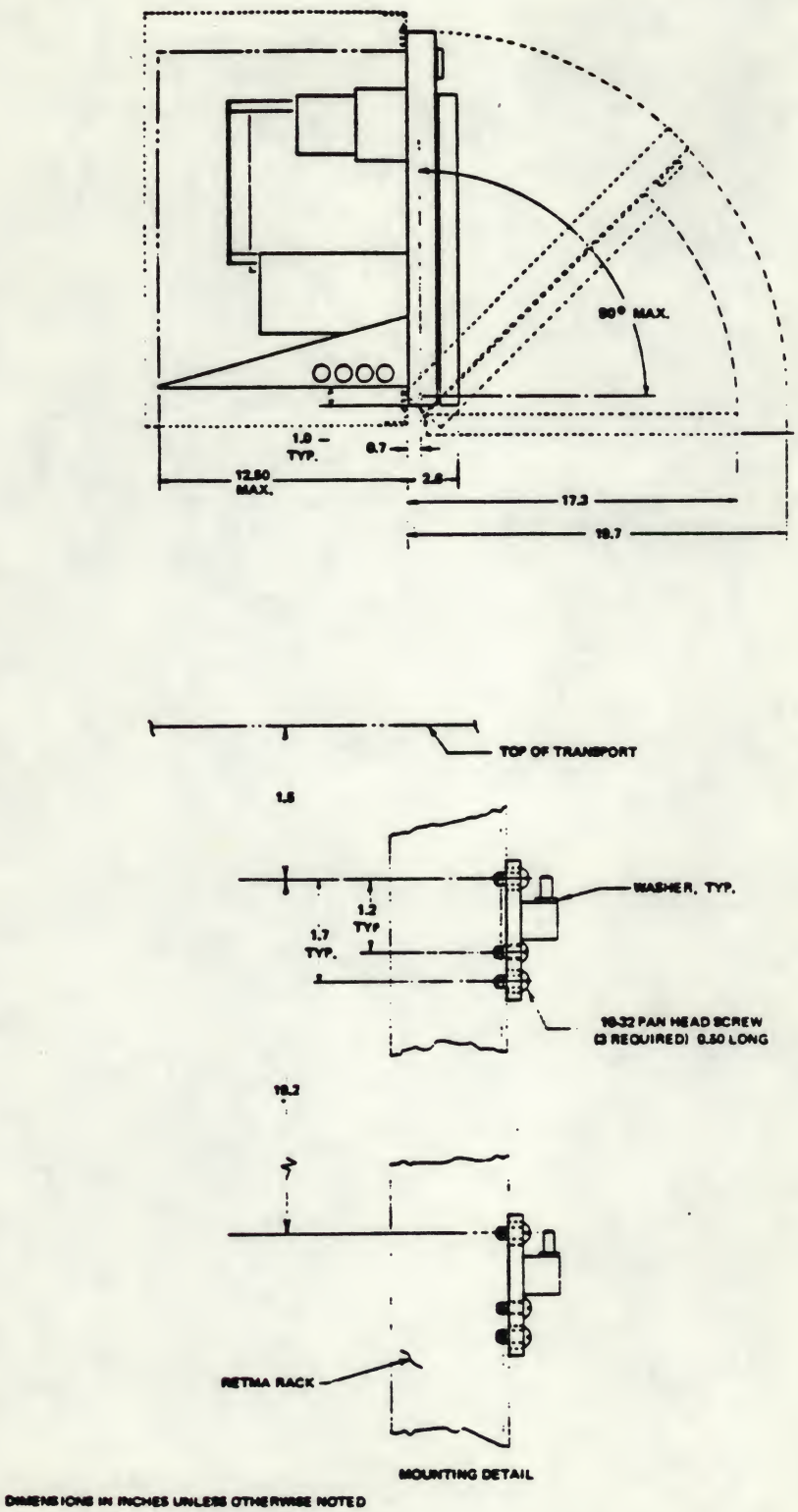


FIGURE 3-5 RACK MOUNTING AND DIMENSIONS (100X)

TABLE 3-2. INTERFACE CONNECTIONS

J101 ON TAPE CONTROL PCBA			
SIGNAL	LIVE PIN	GRN PIN	INPUT/ OUTPUT
Select 1 (SILT1)	A	8	I
Overwrite (IOVW)	B	2	I
Forward (IFWD)	C	3	I
Data Density Select (IDDS)	D	4	I
Reverse (IREV)	E	5	I
Data Density Indicator (IDDI)	F	6	O
Rewind (IRWC)	H	7	I
Select Ø (ISLTØ)	J	8	I
Write Enable (IWEN)	K	9	I
Off-Line (IOFL)	L	10	I
On-Line (IONL)	M	11	O
Rewind (IRWD)	N	12	O
File Protect (IFPT)	P	13	O
Load Point (ILDP)	R	14	O
+5V	S	N/C	O
Ready (IRDY)	T	16	O
End-of-Tape (IEOT)	U	17	O
Select 3 (ISLT3)	V	8	I
Select 2 (ISLT2)	18	8	I
Write Reset (IWRS) Tension Arm only part of IOVW option	15	N/C	I
J102 ON WRITE PCBA			
Write Data Strobe (IWDS)	A	1	I
	B	2	N/C
Write Amplifier Reset (IWARS)	C	3	I
	D	4	N/C
Read Threshold 1 (IRTH1) Omit on new dual mode p/n 154040-0XX	E	5	I
Read Threshold 2 (IRTH2)	F	6	I
	H	7	N/C

TABLE 3-2. INTERFACE CONNECTIONS (Continued)

SIGNAL	LIVE PIN	GRN PIN	INPUT/ OUTPUT
Select Line (Optional)	J	8	I
Select Line (Optional)	K	9	I
Write Data P (IWDP)	L	10	I
Write Data Ø (IWDØ) Omit for 7-track	M	11	I
Write Data 1 (IWD1) Omit for 7-track	N	12	I
Write Data 2 (IWD2)	P	13	I
Write Data 3 (IWD3)	R	14	I
Write Data 4 (IWD4)	S	15	I
Write Data 5 (IWD5)	T	16	I
Write Data 6 (IWD6)	U	17	I
Write Data 7 (IWD7)	V	18	I
J103 ON READ PCBA			
Read Data Parity (IRDP)	1	A	O
Read Data Strobe (IRDS)	2	B	O
Read Data Ø (IRDØ)	3	C	O
Read Data 1 (IRD1)	4	D	O
Select Line (Optional)	5	E	I
Select Line (Optional)	6	F	I
	7	H	N/C
Read Data 2 (IRD2)	8	J	O
Read Data 3 (IRD3)	9	K	O
Non-Return-to-Zero (INRZ) optional on new dual mode p/n 154050-0xx	10	L	O
Seven Track (I7TR) omit on dual mode p/n 154050-0xx	11	M	O

TABLE 3-2. INTERFACE CONNECTIONS (Continued)

SIGNAL	LIVE PIN	GRN PIN	INPUT/ OUTPUT
Single Gap (ISGL) omit on dual mode	12	N	O
Speed (ISP) omit on dual mode	13	P	O
Read Data 4 (IRD4)	14	R	O
Read Data 5 (IRD5)	15	S	O
	16	T	N/C
Read Data 6 (IRD6)	17	U	O
Read Data 7 (IRD7)	18	V	O

TABLE 3-3. INTERFACE INPUTS

INPUT	TYPE	FUNCTION
Select (SLT)	Level	When true, enables all interface drivers and receivers in transport, thus connecting transport to controller.
Forward (FWD)	Level	When true, with transport ready and on line, causes tape to move forward at specified speed.
Reverse (REV)	Level	When true, with transport ready and on line, causes tape to move in reverse at specified speed.
Rewind (RWC)	Pulse	With transport ready and on line, this pulse causes tape to move in reverse at 150 ips to BOT.
Off-Line (OFL)	Level or pulse (min. width, 2 microseconds)	Resets on-line flip-flop to 0 state, placing transport under manual control.
Write Data Strobe (WDS)	Pulse (min., 2 microseconds)	Trailing edge triggers code generator in transport.
Write Data (WD)	9 lines for 9-track; 7 lines for 7-track	When true from 0.5 microsecond before leading edge to 0.5 microsecond after trailing edge of write strobe, results in recording of flux transition when in write mode.
Write Enable (WEN)	Level	When true for 20 microseconds, minimum, after leading edge of FORWARD or REVERSE command, initiates write mode of operation.
Reset (RS)	Pulse (min., 2 microseconds)	When true, resets write amplifier circuits on leading edge. Purpose is to write LRCC at end of record, causing all channels to be erased in IRG.
Data Density Select (DDS)	Level	When true, conditions read electronics to operate in high-density mode. When false, operation is in low-density mode.

TABLE 3-3. INTERFACE INPUTS (Continued)

INPUT	TYPE	FUNCTION
Overwrite (OVW)	Level	When true, conditions appropriate circuitry, in conjunction with Write Reset (WRS) pulse, for updating (rewriting) of select record. Transport must be in write mode.

TABLE 3-4. INTERFACE OUTPUTS

INPUT	TYPE	FUNCTION
On-Line	Level	When true (on-line flip-flop set), transport is under remote control. When false, transport is under local control.
Read Data (RD) (RDP, RD0-7 for 9-channel; RDC, RD2-7 for 7-channel)	Bits	Sampling of RDP, RD0-7 simultaneously on trailing edge of Read Data Strobe (RDS) provides complete data character.
Read Data Strobe (RDS)	Pulse (min., 2 ms)	Provides complete data character when RDP, RD0-7 sampled on trailing edge.
End of Tape (EOT)	Level	True for duration of EOT tab. Transitions to and from true state not to be assumed clean.
Density (DEN)	Level	True only when manual HI DEN switch on transport is set for high density.
Ready (RDY)	Level	True when load sequence is complete and transport is on line and not rewinding. (Transport ready to receive remote command.)
Beginning of Tape (BOT)	Level	True when BOT tab is under photosensor, initial load sequence is complete, and transport is not rewinding.
Rewind (RWD)	Level	True only when transport is engaged in rewind operation or load sequence following rewind.

TABLE 3-4. INTERFACE OUTPUTS (Continued)

INPUT	TYPE	FUNCTION
File Protect (FPT)	Level	True when power is on and reel of tape without write ring is mounted on transport.
NRZ1 Transport Identification (NRZ)	Level (Optional)	True when transport is configured for NRZI data. False level indicates phase-encode configuration.
7-Track Head Identification (7TK)	Level (Optional)	True for 7-track transport; false for 9-track configuration.
Single-Gap Head Identification (SGL)	Level (Optional)	True when transport has single-gap head; false level indicates dual-gap head.
Transport Speed Identification (SPD)	Level (Optional)	True when transport has lower of two speeds available in multiple-transport system.

TABLE 3-5. CONTROL LOGIC OPTIONS

FUNCTION	PURPOSE
STATUS INDICATIONS	When installed, provides status indications to interface when transport is on line and selected. When not installed, status indications are provided whenever transport is selected.
LOCAL/REMOTE DENSITY SELECT	Provides local density control, with indicator, on seven-track models. Provides remote density control, with indicator, on seven-track models. Installed with fixed-density models, Indicator always illuminated.
OVERWRITE	Installed with overwrite option. Note write reset jumper on read/write board.
REWIND/READY	READY signal resets REWIND status. REWIND status resets before READY.
ON LINE/READY	When installed, depression of ON LINE pushbutton will force ready status in middle of tape.
REWIND/OFF LINE	When installed, will cause unit to revert to off-line status when rewind is commanded remotely.
+5V SUPPLY	Diode can be installed (cathode to N, anode to P) to provide +5 volts for customer's terminators.
WRITE ENABLE	Normal configuration: Write Enable line is sampled and stored 20 microseconds after RUN command is given. Output of stored signal becomes Read/Write signal to read/write board. Read/Write signal is controlled directly from Write Enable line.
AUTOMATIC POWER RESTORE	Transport retensions tape and goes on line when power restored after outage.

TABLE 3-6. DATA LOGIC OPTIONS

FUNCTION	PURPOSE
WRITE DATA TIMING	Write data on trailing edge of WDS. Write data on leading edge of WDS.
WRITE RESET	Standard WRS path. Used with overwrite option on read/write models. Only one RESET command required for either overwrite or normal mode.
THRESHOLD COMMAND PATH	Standard path for THRESHOLD command in read/write models. Standard path for automatic THRESHOLD command in read-after-write models.

4.0 BASIC CONCEPTS OF DIGITAL RECORDING

The concept of digital magnetic tape recording has grown in acceptance as a result of the increased use of digital techniques, the increasing variety of recorders available, and the decreased cost of these recorders. The digital recording process involves methods and equipment capable of recording information expressed in a digital (binary) code (1's and 0's). The IBM NRZI system (non-return-to-zero interrupt) is the one most widely used throughout the industry.

Figure 4-1 depicts various codings, including the NRZI code. On magnetic tape, binary 1's are represented by transitions between plus and minus saturation magnetism (+SAT and -SAT) produced by the corresponding write head current. When a written tape is passed across the tape head, a change of flux occurs at the gap. The magnetic heads respond, producing the read voltage waveforms illustrated in Figure 4-1. Absence of a change in flux represents a binary 0, for which no voltage is recovered from the head.

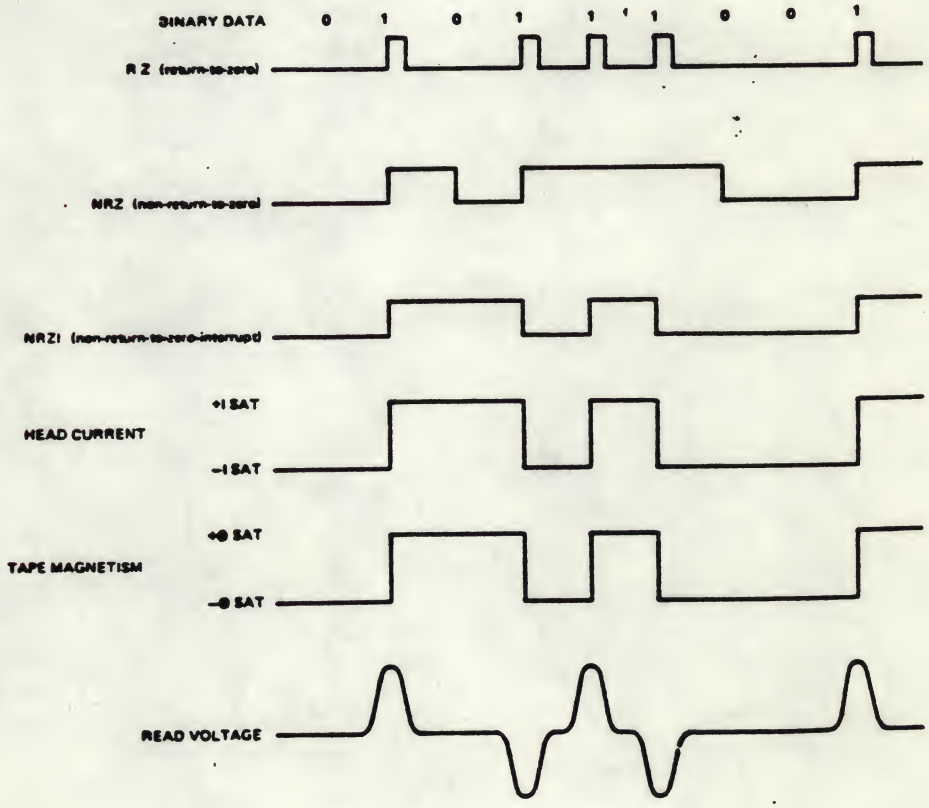


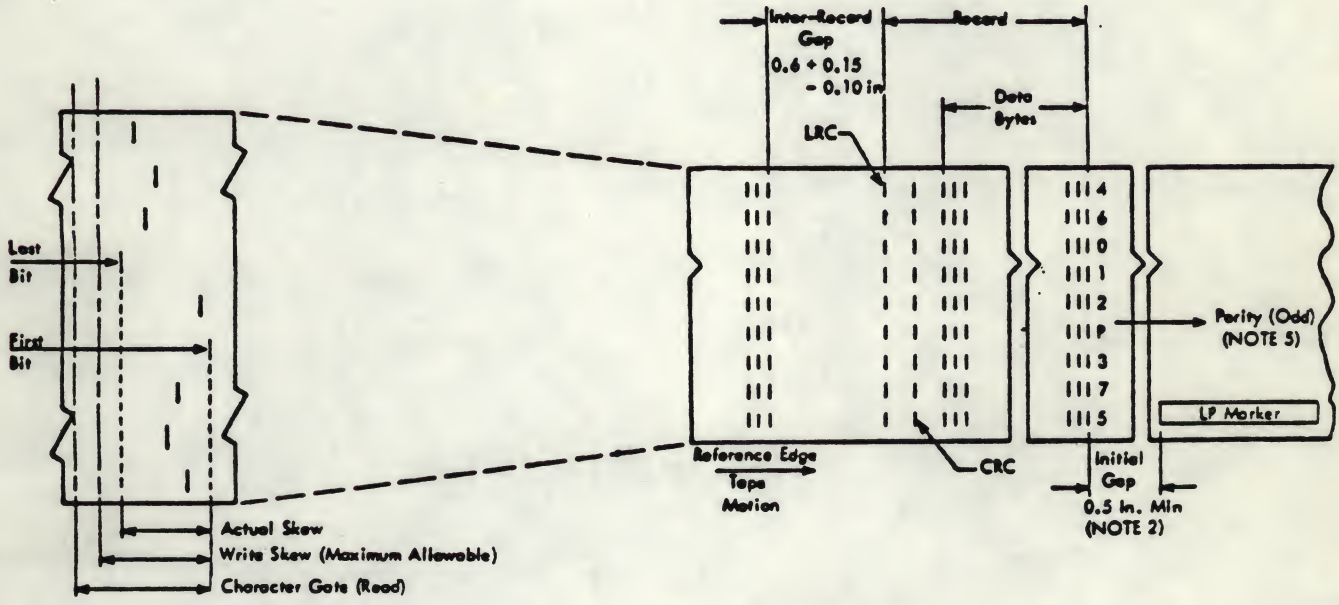
FIGURE 4-1 MAGNETIC RECORDING WAVEFORMS

4.1 NRZI SYSTEM

In the NRZI system, recording is carried out by a saturation current driven through the head in a direction determined by a flip-flop which toggles for each 1 bit recorded. The NRZI system requires the recording of at least one bit for every character. Otherwise, in an all-0 character there would be no indication of the presence of that character.

NINE-TRACK CODING.

Any 8-bit code, such as ASCII or EBCIDIC, may be used. (See Figure 4-2.)



NOTES:

1. Tape shown with oxide side down; NRZI recording. Bit produced by reversal of flux polarity. Tape fully saturated with each direction.
2. Tape to be fully saturated in erased direction in initial gap and inter-record gap; tape to be magnetized so that rim end of tape is north-seeking pole.
3. CRCC: cyclic redundancy check character. Parity of CRCC determined by number of data characters in record. Odd number of data character, even CRCC, etc. CRCC used only in System 360, 800 bpi. CRCC spaced four bits from data characters.
4. LRCC: longitudinal redundancy check character, always odd parity. Spaced four bits from CRCC.
5. Parity bit: vertical parity bit written for each character containing even number of bits.

FIGURE 4-2 NRZI NINE-TRACK DATA FORMAT

LONGITUDINAL REDUNDANCY CHECK CHARACTER (LRCC).

A longitudinal parity bit is written at the end of each record. This character is written by the return of the write head current to the reference condition.

Since the reference condition is established before the first character of the record and reestablished by writing of the LRCC, an even number of 1 bits in each track is written for each record. As the tape is read, the number of 1's read in each track is counted. If the sum is odd, an error is indicated. The LRCC is spaced four character spaces from the end of the block.

CYCLIC REDUNDANCY CHECK CHARACTER (CRCC).

Nine-track, 800-bpi tapes include a CRCC located at the end of each record before the LRCC. The CRCC is generated by application of a complex equation of the data within the block.

This character makes the probability of an undetected error almost zero. The CRCC may be used with the computer read function to determine which track contains the error. The information supplied by the CRCC, combined with that of the LRCC and vertical parity, may be used to correct detected errors. Errors involving more than one track within the same record are not correctable.

4.2 PHASE-ENCODE SYSTEM

The differences between phase-encoded (PE) and NRZI writing are chiefly in presentation and phasing or coding. In NRZI coding, a single change of polarization on the tape represents a logical 1, while no change represents a logical 0. In PE writing, both the logical 1 and 0 involve changes in polarization. Phasing, however, is the key difference between PE and NRZI. The major advantages offered by PE are reduced possibility of losing data because of inadequate signal strength (making practical low read thresholds) and the fact that each track is self-clocking, reducing skew problems. PE writing is done only in a nine-track mode. Basic features of the PE system are as follows (Figure 4-3):

a. A change in tape polarity at the interface from negative to positive is a 1 bit.

b. A change from positive to negative is a 0 bit.

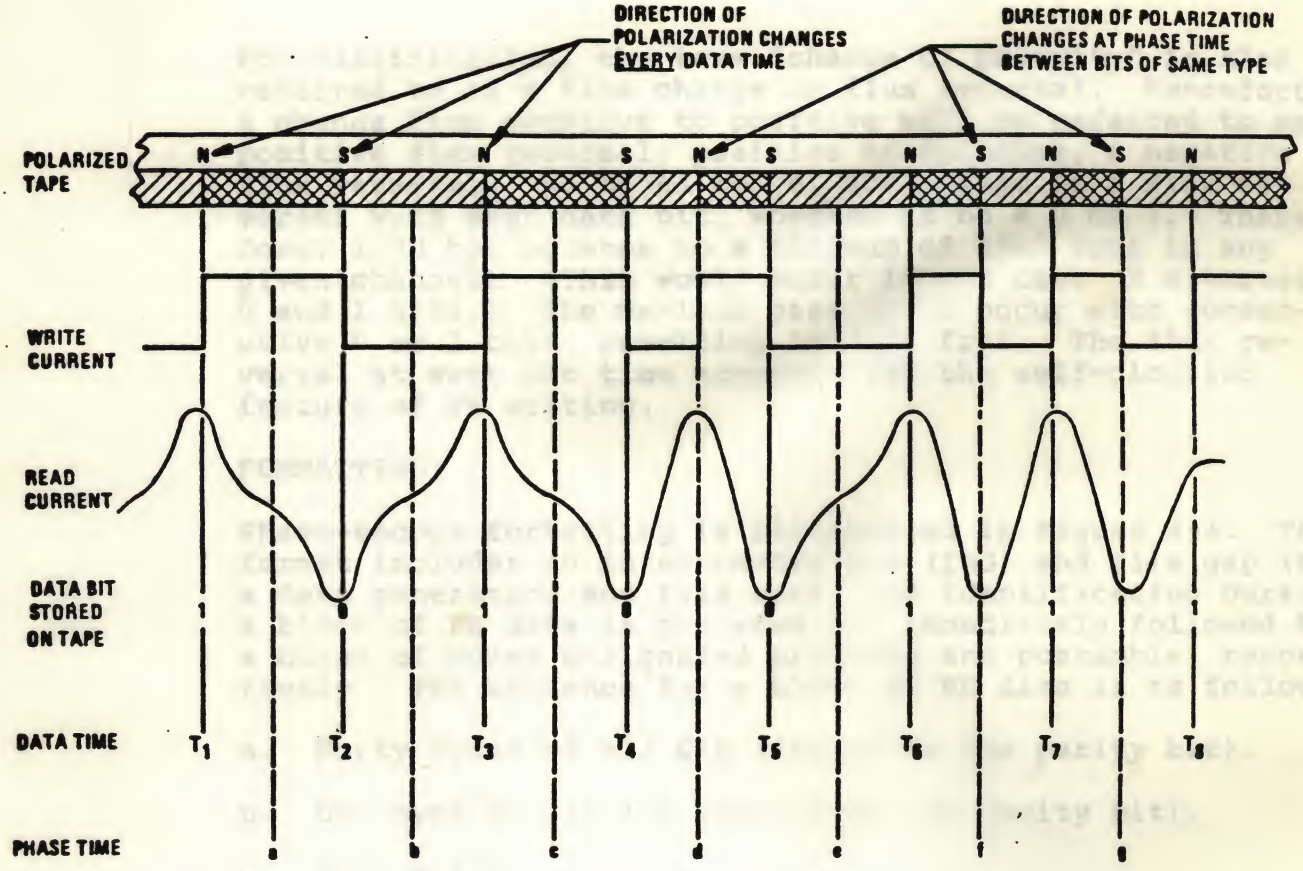


FIGURE 4-3 PHASE-ENCODED TAPE MAGNETIZATION

c. There must be a change of polarity between data bits of the same polarity (consecutive 1 or 0 bits) at phase time.

   (1) Two consecutive 1 bits must be separated by a change at phase time from positive to negative polarity.

   (2) Two consecutive 0 bits must be separated by a change at phase time from negative to positive polarity.

d. There must be a change of polarity at each data bit time.

e. There must not be a change of polarity at the phase time between alternate data states.

f. The PE transport records and reads data at a density of 1600 bits per inch (bpi) of tape travel.